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Benthic Infaunal Survey of Alice Arm and Hastings Arm, British Columbia – October, 1989

by
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Canadian Data Report of Hydrography and Ocean Sciences No. 82

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Canadian Data Report Of Hydrography and Ocean Sciences

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ABSTRACT

Burd, B.J. and R.O. Brinkhurst. 1990. Benthic Infaunal Survey of Alice Arm and Hastings Arm, B.C. - October, 1989. Can. Data Rep. Hydrogr. Ocean Sci. No. 82. 23pp.

In October 1989, a benthic invertebrate faunal suvey was conducted in Alice Arm and Hastings Arm, British Columbia. In this report, we include raw data from that survey and preliminary statistical analyses of this dataset. This represents the fourth in a series of similar benthic surveys conducted in this area since 1982.

Keywords: Benthic Infauna, Alice Arm.

RESUMÉ

Burd, B.J. and R.O. Brinkhurst. 1990. Benthic Infaunal Survey of Alice Arm and Hastings Arm, B.C. - October, 1989. Can. Data Rep. Hydrogr. Ocean Sci. No. 82. 23pp.

En octobre 1989 un relevé de la faune benthique des invertebrés a été réalisé dans le bras Alice et dans le bras Hastings, Colombie-Britannique. Ce rapport présente des données brutes du relevé et des analyses statistiques préliminaires de cette série de données. Le rapport représente le quatriènne rapport d'une série de relevés benthiques pareils realisés dans cette region depuis 1982.

Mots-clés: faune benthique, Alice Arm.

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INTRODUCTION

This report outlines the results of the fourth benthic infaunal survey of Alice Arm and Hastings Arm carried out by the Ocean Ecology Division of the Institute of Ocean Sciences, Sidney, British Columbia. The first three surveys are detailed in Kathman et al. (1983,1984) and Brinkhurst et al. (1987). The four surveys were conducted in October of 1982, 1983, 1986 and 1989. The data for the 1989 cruise, contained herein, were analysed as part of a Supply and Services contract with Galatea Research Inc.

The study was initiated to examine the long-term effects of mine tailings discharges on the benthic invertebrate fauna of Alice Arm, B.C. The AMAX Kitsault molybdenum mine discharged tailings into the head of Alice Arm for 18 months, ending in November 1982, when the mine closed operations indefinitely.

METHODS

Benthic sampling methods are detailed in Brinkhurst et al. 1987. The sampling was conducted by personnel from the Institute of Ocean Sciences and Galatea Research Inc. aboard CSS Vector in October 1989. Station coordinates and depths are given in Table 1. Sample areas and station locations are illustrated in Figures 1 and 2. Two replicate grabs (Smith-McIntyre 0.1m2 area) were taken at each sampling location in Alice Arm and Hastings Arm. A core sample was taken from each grab for sediment particle size analysis (see Brinkhurst et al. 1987). Results of sediment analyses are given in Table 2.

The remainder of each sample was washed through a 1.0mm screen, preserved and later sorted in the laboratory at the Institute of Ocean Sciences into major taxonomic groups. Twenty percent of the samples (5 of 24) were then resorted by the taxonomic supervisor. If more than 5% additional animals had been found during the resort in any given sample, the entire set of samples would have been resorted. This quality control data is given in Table 3.

Taxa were identified by the following authorities:

Polychaeta	Dr. Howard Jones, Marine Taxonomic Services, Corvallis, Oregon.
Crustacea, Echinodermata Varia	Dr. William Austin, Khoyatan Marine Laboratory, Duncan, B.C.
Amphipoda	Dr. Craig Staude, Friday Harbour Marine Laboratory
Mollusca	Dr. Robert Reid, University of Victoria

A list of taxa identified during the study, and the resulting abundances per 0.1m2 are given for each taxon and station in Appendices 1 and 2.

DATA ANALYSIS

Following the methods in Brinkhurst et al. 1987, a Bray-Curtis cluster analysis was carried out first to show groupings of individual replicate samples (Figure 3), followed by the same analysis averaging replicates for each station (Figure 4), with significance testing for the validity of cluster groupings (SIGTREE - Nemec and Brinkhurst 1988a). The null hypothesis that a given grouping was homogeneous (no significant differences between stations) was tested for each linkage. The results are given in Appendix 3.

A similar cluster analysis was carried out including depth, percent silt/clay and percent sand for each replicate (Figure 5). The Ho that each linkage in the abundance dendrogram (Figure 4) was significantly different from the same linkage in the depth/sediment dendrogram (Figure 5) was tested using COMTRE1 (Nemec and Brinkhurst 1988b). Results are given in Appendix 4.

ACKNOWLEDGEMENTS

The authors extend their thanks to D. Moore and the crew of the CSS *Vector*, Institute of Ocean Sciences, J. Boyd and D. Goyette, Environment Canada, and D. Bright, Biology Department, University of Victoria, for technical assistance and cooperation during the 1989 field sampling program. Sorting of taxa into taxonomic groups was contracted to Moira Galbraith.

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Kathman, R.D., R.O. Brinkhurst, R.E. Woods and D.C. Jeffries. 1983. Benthic studies in Alice Arm and Hastings Arm, B.C. in relation to mine tailings dispersal. Can. Tech. Rep. Hydrogr. Ocean Sci. 22: 30pp.

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Nemec, A. and R.O. Brinkhurst. 1988a. Using the bootstrap to assess statistical significance in the cluster analysis of species abundance data. Can. J. Fish. Aquat. Sci. 45: 965-970.

Nemec, A. and R.O. Brinkhurst. 1988b. The Fowlkes-Mallows statistic and pattern recognition in cluster analysis. Can. J. Fish. Aquat. Sci. 45: 971-975.

Table 1. Station locations and depths for Alice Arm, 1989.

Station	Latitude	Longitude	Depth
CCNA	5526.7	12631.7	280
CCNB	5526.7	12631.7	278
CCMA	5526.6	12932.0	294
CCMB	5526.6	12932.0	296
CCSA	5526.5	12931.7	240
CCSB	5526.5	12931.7	271
DDNA	5526.8	12933.7	365
DDNB	5526.8	12933.7	362
DDMA	5526.8	12933.6	370
DDMB	5526.8	12933.6	374
DDSA	5526.7	12933.6	371
DDSB	5526.7	12933.6	369
EENA	5527.2	12937.1	403
EENB	5527.2	12937.1	400
EEMA	5527.1	12937.0	402
EEMB	5527.1	12937.0	401
EESA	5527.0	12937.0	394
EESB	5527.0	12937.0	395
Z2WA	5529.2	12945.9	321
Z2WB	5529.2	12945.9	322
Z2MA	5529.2	12945.6	321
Z2MB	5529.2	12945.6	322
Z2EA	5529.3	13045.4	267
Z2EB	5529.3	13045.4	267

Table 2. Sediment particle size analysis for Alice Arm 1989.

Station	%gravel	%sand	%mud
CCNA	0.00	7.54	92.40
CCNB	0.00	2.12	97.80
CCMA	0.00	1.45	98.50
CCMB	0.00	9.22	90.70
CCSA	0.86	14.20	84.90
CCSB	0.08	32.20	67.60
DDNA	0.15	15.20	84.50
DDNB	0.04	5.39	94.50
DDMA	0.00	18.60	81.30
DDMB	0.38	22.20	77.30
DDSA	0.00	32.40	67.50
DDSB	0.00	34.50	65.40
EENA	0.00	1.99	98.00
EENB	0.00	2.49	97.50
EEMA	0.00	2.57	97.40
EEMB	0.00	2.44	97.50
EESA	0.00	3.29	96.70
EESB	0.00	2.01	97.90
Z2WA	0.00	0.56	99.40
Z2WB	0.00	0.32	99.60
Z2MA	0.25	0.75	99.00
Z2MB	0.00	0.28	99.70
Z2EA	0.00	0.65	99.30
Z2EB	0.00	0.71	99.20

Table 3. Quality Assurance/ quality control resort count from Alice Arm, B.C., October 1989.

Station	No. repicked	Percent of total animals
CCMA	1	1.6
DDMA	3	5.0
Z2WA	1	* 13.0

*The repick represents only one specimen. The percentage is so high because the total abundance from this sample was so low, yet the amount of debris was great. Therefore it was considered a poor choice for QC and the high value was ignored.

Fig. 1. Map showing general location of study area.

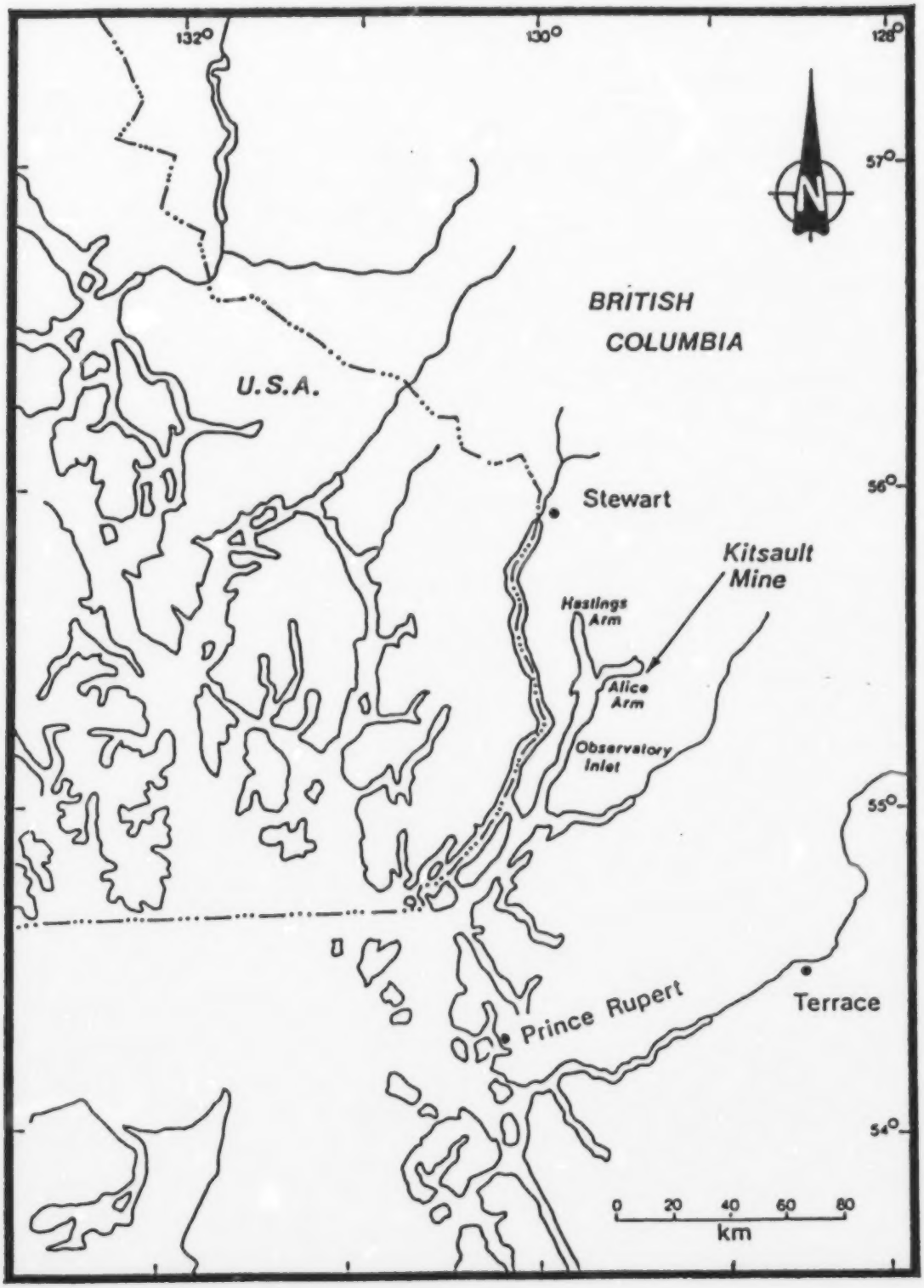
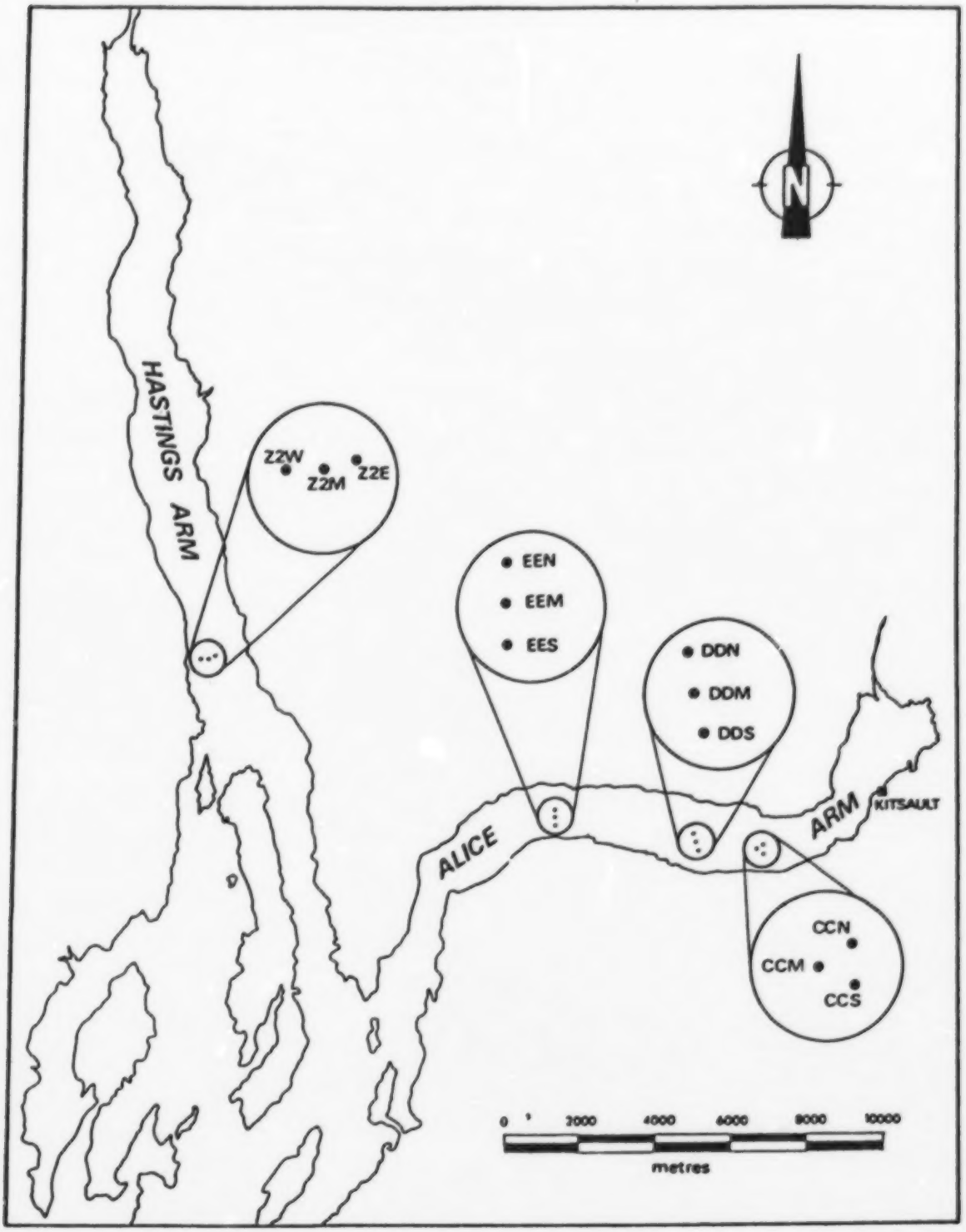


Fig. 2. Station locations in Alice Arm and Hastings Arm, British Columbia.



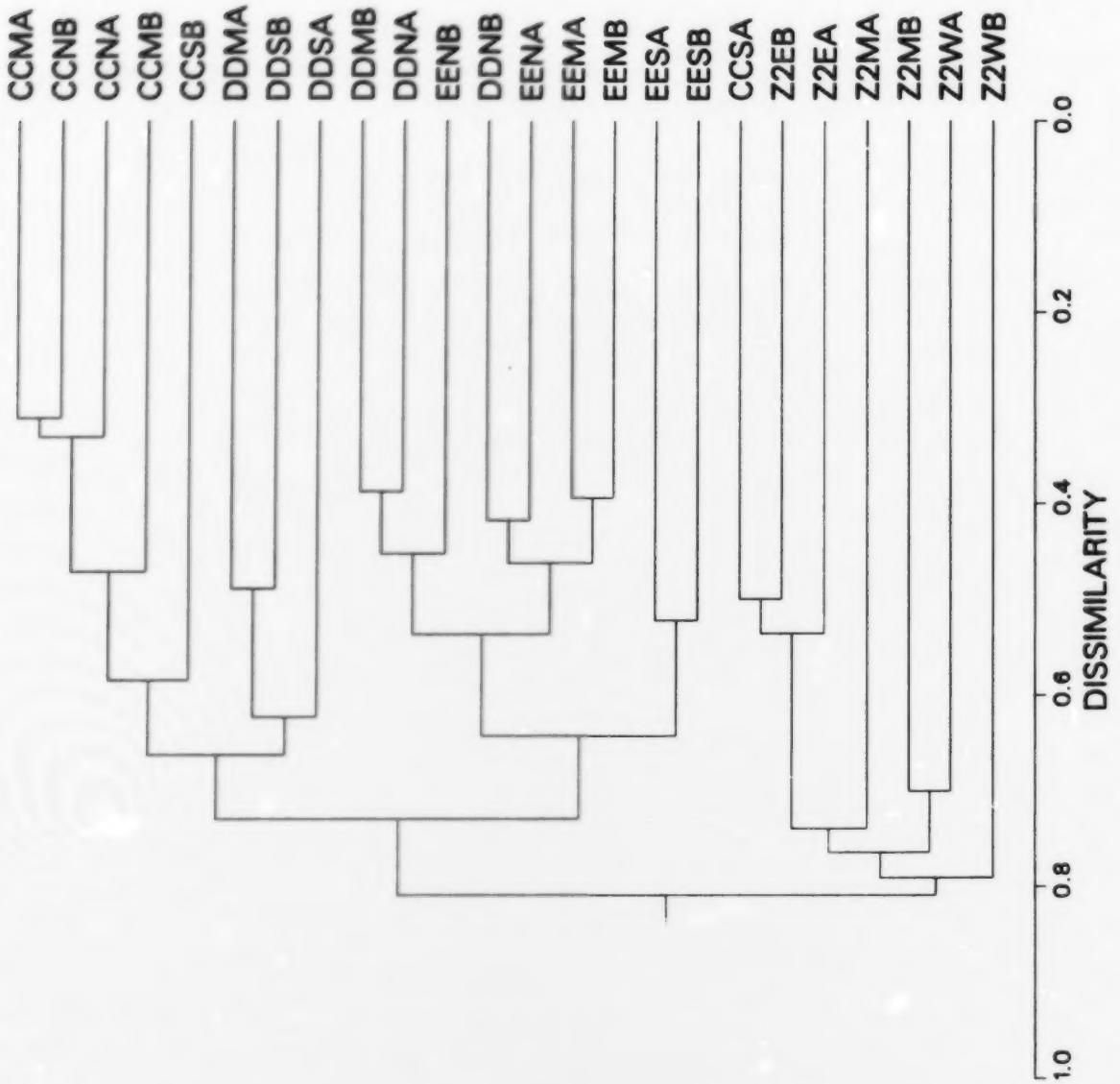


Figure 3. Cluster dendrogram showing groupings of all individual replicates for the Alice Arm 1989 species abundance data. Linkages are based on UPGMA (unweighted pair group mean average sort).

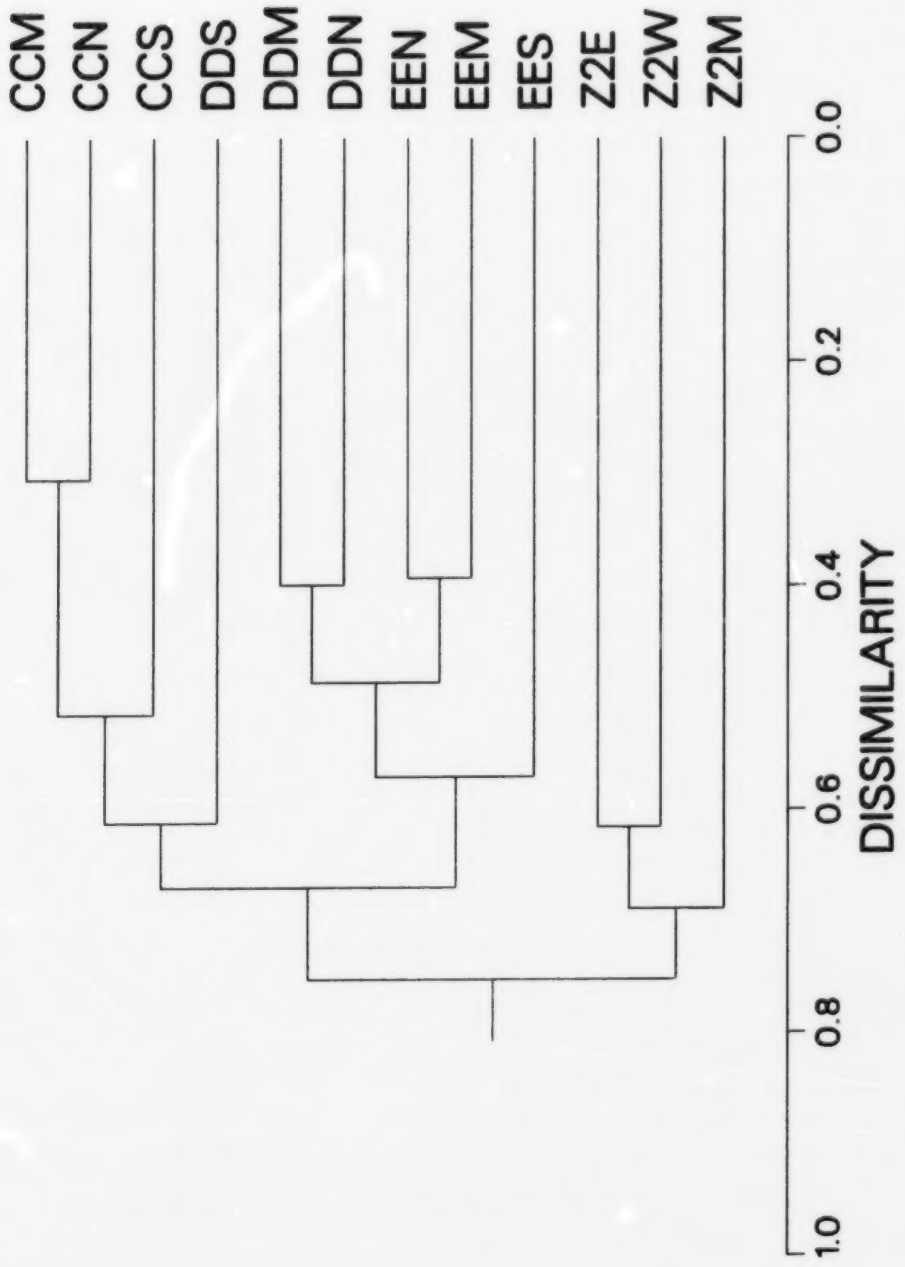


Figure 4. Cluster dendrogram showing groupings of stations (replicates averaged - UPGMA linkage) for the 1989 Alice Arm abundance data. There were no significant linkages at the 5% level.

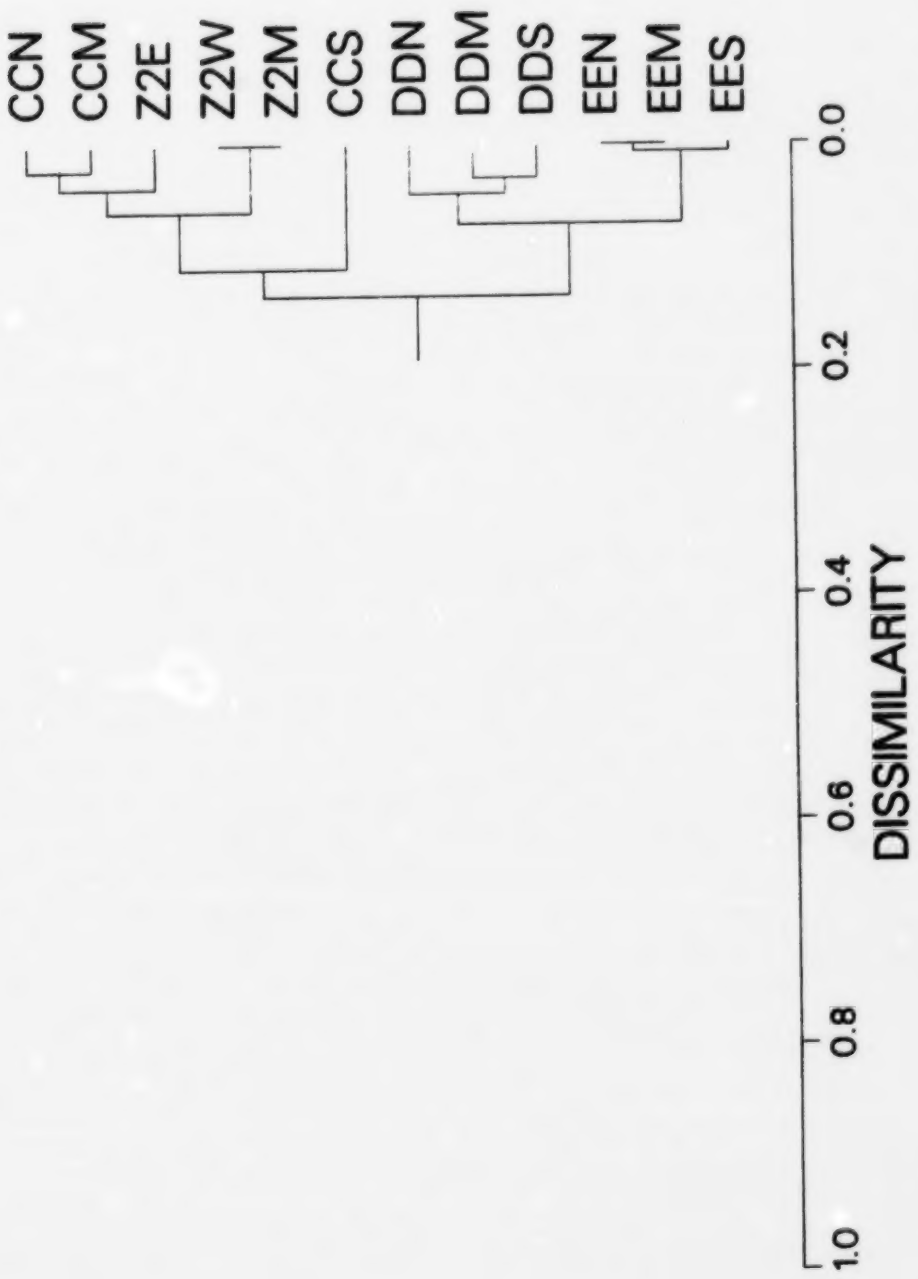


Figure 5. Cluster dendrogram showing groupings of stations (replicates averaged - UPGMA linkage) for the Alice Arm 1989 depth/ sediment particle size data.

Appendix 1. Taxa identified from benthic surveys in Alice Arm in 1982, 1983, and 1986. Brackets denote taxonomic synonyms from Austin (1985). Asterisks denote taxa not included by Austin (1985).

TAXON	SURVEY YEAR 1982	1983	1986	1989
PORIFERA				
Hexactinellida				
Rossellidae	x			
CNIDARIA				
Anthozoa				
Pennatulacea		x		
Virgularidae				
Virgularia cf. tuberculata	x		x	
Virgularia cf. cystiferum				x
Edwardsiidae				
Edwardsia sipunculoides		x		
PLATYHELMINTHES				
Turbellaria			x	
Polycladida	x		x	
NEMERTEA				
Nemertea	x		x	
Anopla				
Lineidae				
Cerebratulus sp.	x	x	x	
Micrura alaskensis	x			
Enopla				
Hoplonemertea	x			
NEMATODA				
Nematoda indet.	x			
ANNELIDA				
Oligochaeta				
Tubificidae				
Limnodriloides sp.	x			
L. victoriensis	x			
Polychaeta				
Polynoidae				
Polynoidae indet.			x	x
Antinoella? sarsi*		x		
Eunoe sp.		x		
Harmothoe imbricata				x
Gattyana treadwelli		x		
Sigalionidae				
Pholoe minuta [P. caeca]	x	x	x	x

Appendix 1. Continued

TAXON	1982	1983	1986	1989
Hesionidae				
Gyptis brevipalpa	x	x		x
Trochochaetidae				
Ancistrosyllis sp.		x		
A. groenlandica	x	x	x	x
Phyllodocidae				
Eteone (Mysta) sp.	x			
E. columbiensis*	x			
Phyllodoce groenlandica [Anaitides groenlandica]	x			
Nephtyidae				
Nephtys sp.			x	
N. cornuta cornuta	x	x	x	x
N. punctata	x	x	x	x
Aglaophamus sp.			x	x
A. malmgreni*	x	x	x	
Gonianidae				
Glycinde armigera	x		x	x
G. picta				x
Goniada annulata	x	x	x	x
Sphaerodoridae				
Sphaerodoropsis sphaerulifer	x			
Lumbrineridae				
Lumbrineridae indet.			x	
Lumbrineris sp.	x		x	x
L. luti [L. lutei]	x	x	x	x
Paraninoe simpta	x	x	x	x
Orbiniidae				
Leitoscoloplos pugettensis	x	x	x	x
L. elongatus	x	x		
Paraonidae				
Levisenia gracilis*	x	x	x	x
Aricidea suecica [Allia nolani]		x	x	
A. nr. cerruti*			x	
Cirrophorus branchiatus	x			
Acesta lopezi [Aricidea lopezi]	x			x
Acesta catherinae				x
Dorvilleidae				
Schistomeringos sp.	x			
Spionidae				
Polydora sp.		x		
Prionospio sp.	x			
P. cirrifera	x			
P. steenstrupi	x	x	x	x
Spiophanes sp.	x	x	x	
S. kroyeri	x	x	x	x
Pseudopolydora kempi?	x			

Appendix 1. Continued

TAXON	1982	1983	1986	
Trochochaeta multisetosa	x			
Chaetopteridae				
Spiochaetopterus costarum	x			
Cirratulidae				
Cirratulidae indet.	x		x	
Caulleriella hamata	x			x
Tharyx multifilis		x	x	x
Chaetozone setosa	x	x	x	
Chaetozone spinosa				x
Cossuridae				
Cossura longocirrata			x	x
C. soyeri	x			
Flabelligeridae				
Brada sp.	x			
Brada sacchalina				x
B. villosa	x	x	x	x
Flabelligera affinis			x	x
Pherusa sp.	x			
P. plumosa			x	x
Syllidae				
Exogone sp.1	x			
E. sp.2	x			
E. gemmifera [E. naidina]	x			
Eusyllis cf. blomstrandi	x			
Syllis sp.	x			
S. alternata	x			
Sternaspidae				
Sternaspis scutata	x	x	x	x
Opheliidae				
Ophelina breviata	x			
Capitellidae				
Capitellidae indet.			x	
Capitella capitata	x			x
Heteromastus sp.	x			
H. filobranchus	x	x	x	x
Mediomastus sp.	x			
Mediomastus californiensis				x
Decamastus sp.	x			
Maldanidae				
Maldanidae indet.	x			
Maldane glebifex	x	x	x	
Praxillella gracilis			x	x
Rhodine sp.	x			
Oweniidae				
Owenia fusiformis	x			
Myriochele oculata	x	x		
Galathowenia* nr. oculata			x	x
Pectinariidae				
Pectinaria sp.	x			

Appendix 1. Continued

TAXON	1982	1983	1986	1989
Amphictene moorei	x	x	x	x
Ampharetidae				
Ampharetidae indet.			x	x
Anobothrus gracilis	x			
Amage anops	x			
Ampharete finmarchica		x	x	x
Amphicteis sp.		x		
A. cf. scaphobranchiata	x			
Sosanopsis cf. hesslei	x			
Terebellidae				
Pollycirrus sp.	x			
Artacama conifera			x	
Pista cristata	x			
Trichobranchidae				
Terebellides sp.	x			
T. stroemi	x	x	x	x
Sabellidae				
Euchone sp.	x			
E. hancocki?			x	
Jasmineira pacifica	x			
MOLLUSCA				
Aplacophora				
Aplacophora indet.	x		x	
Crystallophrissonidae				
Crystallophrisson sp.		x	x	x
Chaetodermatidae				
Chaetoderma sp.		x		
Gastropoda				
Gastropoda indet.			x	
Columbellidae				
Mitrella gouldi			x	
Rissoinidae				
Rissoina newcombei		x		
Vitrinellidae				
Vitrinella sp.	x			
V. columbiana			x	x
Naticidae				
Natica russa [N. clausa]			x	
Polinices pallidus				x
Muricidae				
Ocenebra interfossa		x	x	x
Pyramidellidae				
Odostomia tenuisculpta			x	
Turbonilla sp.	x			
Cylichnidae				
Cylichna alba		x	x	
C. attonsa	x	x	x	x
Atyidae				
Haminoea vesicula			x	

Appendix 1. Continued

TAXON	1982	1983	1986	1989
Limacinidae				
Limacina sp.	x			
Buccinidae				
Buccinum sp.	x			
Buccinum glaciale				x
Gastropteridae				
Gastropteron pacificum	x			
Philinidae				
Philine polaris				x
Bivalvia				
Nuculidae				
Nucula tenuis	x	x	x	x
Nuculanidae				
Nuculana sp.		x		
Nuculana radiata				x
N. hamata			x	
N. hindsii*		x		
N. minuta*	x			
Yoldiidae				
Yoldia amydalea	x		x	x
Y. hyperborea [Y. hyperboria]		x	x	x
Y. myalis	x			
Y. scissurata		x		
Y. thraciaeformis		x	x	
Y. beringiana	x			
Y. martyria	x	x	x	x
Mytilidae				
Mytilus edulis			x	
Lucinidae				
Lucina tenuisculpta		x		
Thyasiridae				
Adontorhina cyclia				x
Axinopsida serricata			x	
Thyasira flexuosa [T. barbarensis]			x	x
Ungulidae				
Diplodonta orbella	x			
Cardiidae				
Clinocardium nuttallii		x		
Pectinidae				
Delectopecten vitreus				x
Tellinidae				
Macoma sp.	x			
M. calcarea		x		
M. eliminata		x		
M. brota			x	x
M. carlottensis	x	x	x	
M. cf. nasuta	x			

Appendix 1. Continued

TAXON	1982	1983	1986	1989
Transenella tantilla	x			
Psephidia lordi		x	x	x
Cooperellidae				
Cooperella sp.	x			
C. subdiaphana		x	x	
Myidae				
Mya arenaria		x		
Hiatellidae				
Hiatella arctica	x			
Montacutidae				
Nearomya rugifera			x	
Scaphopoda				
Dentallidae				
Dentalium agassizii		x		
D. pretiosum		x	x	x
D. rectius*	x	x	x	x
Cadulidae				
Cadulus californicus [Polyschides californicus]	x			
Cadulus aberrans				x
C. tolmiei		x	x	
ARTHROPODA				
Crustacea				
Crustacea indet.			x	
Ostracoda				
Ostracoda indet.		x		
Myodocopa undesc.			x	
Halocyprididae				
Spinoecia spinirostris			x	
Philomdidae				
Scleroconcha trituberculatus			x	
Rutidermatidae				
Rutiderma lomae				x
Copepoda				
Calanidae				
Neocalanus plumchrus			x	
Metridiidae				
Metridia okhotensis			x	
M. pacifica			x	
Mysidacea				
Mysidae				
Holmesiella anomola		x		
Pseudomma truncatum	x			
Cumacea				
Leuconidae				
Leucon sp.	x			
L. subnasica		x		
Eudorella sp.	x			
E. emarginata			x	
E. pacifica		x		x

Appendix 1. Continued

TAXON	1982	1983	1986	1989
Diastylidae				
Diastylis aspera?			x	
D. pellucida		x		
D. paraspinulosa [D. parasinulosa]			x	
D. umatillensis				x
Nannastacidae				
Campylaspis? papillata [C. rubromacullata]	x			
Tanaidacea				
Leptognathiidae				
Leptognathia sp.	x			
Leptognathia gracilis				x
Amphipoda				
Corophiidae				
Corophium acherusicum			x	
Eusiridae				
Eusiridae frag.			x	
Rhacotropis? sp.	x			
Lysianassidae				
Cyphocaris challengerii	x			
Menigratopsis sp.			x	
Koroga megalops	x	x	x	x
Pachynus barnardi	x	x		
Orchomene obtussa	x			x
Oediceritidae				
Oedicerotidae indet.	x		x	
Oediceros sp. [Oediceroides sp.]			x	
Bathymedon sp.			x	
B. pumilis	x	x		x
Monoculodes sp.		x	x	
M. cf. emarginatus	x	x		
M. glyconica				x
Phoxicephalidae				
Foxiphalus obtusidens			x	
Harpiniopsis? sp.			x	
Heterophoxus oculatus			x	x
Paraphoxus oculatus	x		x	
Synopiidae				
Syrrhoe sp.			x	
Hyperiidae				
Hyperia sedusarum [H. medusarum]	x			
Parathemisto sp.	x			
P. pacificus	x			
Dulichiidae				
Dulichia rhabdoplastis				x
Calliopiidae				
Oradarea longimana				x

Appendix 1. Continued

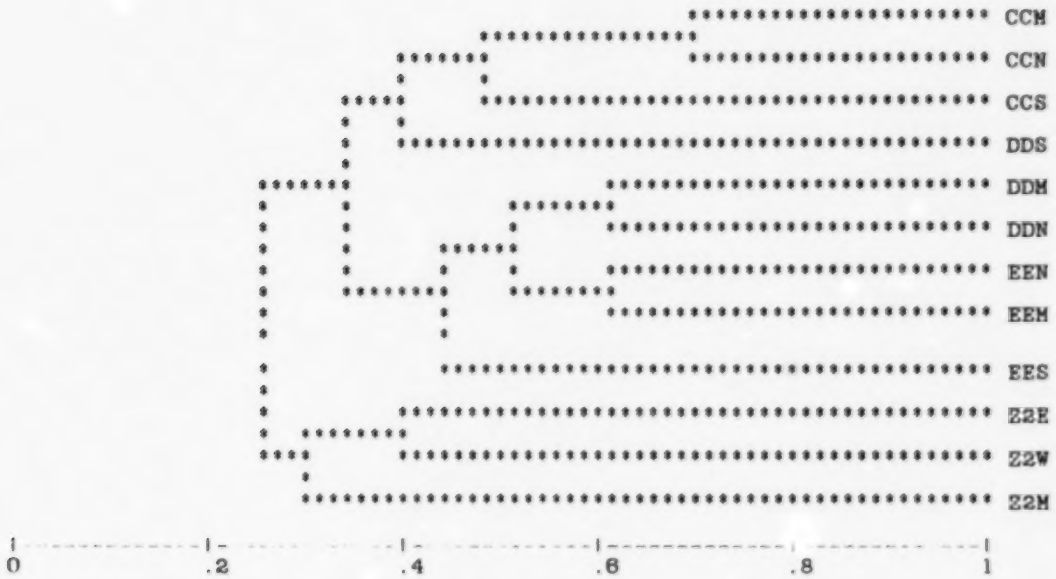
TAXON	1982	1983	1986	1989
Scinidae				
Scina borealis				x
Decapoda				
Decapoda indet.	x			
Pinnotheridae				
Pinnixa cf. eburna			x	
Pasiphaeidae				
Pasiphaea pacifica			x	
SIPUNCULA				
Sipuncula indet.			x	
Golfingiidae				
Golfingia sp.			x	
ECHIURA				
Echiura indet.	x		x	
BRYOZOA				
Bryozoa indet.		x		
ECHINODERMATA				
Ophiuroidea			x	
Ophiuridae				
Ophiura sp.	x		x	x
O. sarsi	x			x
O. leptoctenia	x	x	x	x
Amphiuridae				
Amphiuridae indet.			x	
Amphioplus strongyloplax			x	
Echinoidea				
Strongylocentrotidae				
Strongylocentrotus sp. juv.				x
Strongylocentrotus pallidus			x	
Holothuroidea				
Holothuroidea indet.			x	
Chirodotidae				
Chirodota albatrossi	x	x	x	x
Molpadiidae				
Molpadia intermedia	x	x	x	x
Asteroidea				
Ctenodiscus crispatus				x
TOTAL TAXA	123	74	110	79

Appendix 2. Alice Arm species abundance data.
Number of taxa per $0.1m^2$.

TAXA	CCMA	CCMB	CCNA	CCNB	CCSA	CCSB	DDMA	DDMB	DDNA	DDNB	DDSA	DDSB	EEMA	EEMB	EENA	EENB	EESA	EESB	Z2EA	Z2EB	Z2NA	Z2NB	Z2WA	Z2WB
POLYCHAETA																								
Amphorete finmarchica	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ampharetidae sp. Indet.	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Amphictene moorei	2	2	2	2	0	4	0	1	6	2	3	2	0	2	0	0	2	0	0	0	0	0	0	0
Ancistrosyllis groenlandica	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Acesta catherinae	0	0	0	0	0	0	0	1	0	0	9	1	0	0	0	0	0	0	0	0	2	0	0	0
Acesta lopezi	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
Brada sachalina	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
Brada villosa	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0	0	0	0	0
Capitella capitata complex	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Chaetozone spinosa	0	1	0	0	0	8	0	0	0	0	4	1	0	0	0	0	1	0	0	0	0	0	0	0
Cirratulidae sp. Indet.	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cossura longocirrata	0	0	0	0	0	0	4	0	0	0	12	3	0	0	0	0	0	0	0	0	0	0	0	0
Flabelligera affinis	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Galathowenia oculata	4	7	2	7	0	2	2	4	18	0	3	1	0	0	0	1	0	0	0	0	4	0	0	0
Glycinde armigera	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Glycinde picta	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0
Goniada annulata	0	1	0	0	0	0	0	1	1	0	2	0	1	2	1	2	1	0	0	0	0	0	0	0
Gyptis brevipalpa	0	0	0	0	0	0	0	1	0	1	2	0	3	0	1	1	1	1	0	0	1	0	0	3
Harmothoe imbricata	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Heteromastus filobranchus	1	0	0	0	0	0	0	1	0	0	1	1	0	0	1	1	0	0	1	0	3	2	0	0
Leitoscoloplos pugettensis	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0
Levinsenia gracilis	0	0	2	0	5	19	5	1	3	3	5	6	3	1	0	1	0	5	4	3	2	0	1	1
Lumbrineris luti	0	3	0	0	0	1	0	0	0	0	3	0	1	0	0	0	0	1	0	0	0	0	0	0
Lumbrineris sp. Indet.	0	1	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0
Maldane glebifex	0	0	0	0	0	4	1	0	0	0	0	3	0	0	0	0	0	0	0	0	1	0	0	0
Mediomastus californiensis	0	0	0	0	0	1	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0
Nephtyidae sp. Indet.	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
Nephtys cornuta cornuta	1	3	1	2	0	9	6	2	1	2	22	6	1	1	0	0	0	0	0	0	0	0	0	0
Nephtys punctata	0	0	0	0	0	0	0	0	1	2	0	2	0	1	0	1	0	1	0	1	0	1	0	0
Paraninoe simpta	2	0	0	0	2	1	2	1	0	0	0	0	2	1	2	3	1	0	0	1	0	1	1	1
Pherusa plumosa	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0
Pholoe minuta	0	3	1	0	0	0	0	0	2	0	5	1	0	0	2	0	0	0	0	0	0	0	0	0
Polynoidae sp. Indet.	0	1	0	0	0	0	0	0	0	0	5	1	0	0	0	0	0	0	0	1	0	0	0	0
Prionospio steenstrupi	1	1	0	1	0	2	1	0	0	0	5	1	0	1	0	0	1	0	1	0	0	0	0	0
Spiophanes kroyeri	0	4	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1
Sternaspis scutata	2	2	1	2	0	2	4	9	4	0	1	0	0	1	0	0	0	0	0	0	0	0	1	3
Terebellides stroemi	0	0	1	0	0	0	0	0	1	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0
Tharyx multifilis	0	0	0	0	0	0	0	2	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0
BIVALVIA																								
Adontorhina cyclia	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Delectopecten vitreus	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Macoma brota	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Neaeromya myaciformis	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Nucula tenuis	3	2	4	2	1	3	0	5	2	5	1	0	4	0	1	1	3	0	2	1	8	1	3	0
Nuculana radiata	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Psephidia lordi	0	0	0	0	0	0	1	20	24	12	0	0	10	35	14	10	5	4	0	1	0	0	0	1
Thyasira gouldi	4	2	2	2	3	0	1	2	1	1	1	1	1	1	1	1	0	0	2	4	1	0	0	0
Yoldia amygdalea	0	0	0	0	0	0	1	0	0	0	0	0	1	1	1	0	0	2	0	0	1	0	0	0
Yoldia martyria	2	1	1	1	0	2	0	0	1	3	1	1	0	1	5	2	1	0	0	0	0	0	1	0
Yoldia hyperborea	0	0	0	0	0	0	0	1	0	0	0	0	0	1	2	0	0	0	0	0	0	0	1	0

TAXA	CCMA	CCMB	CCWA	CCWB	CCSA	CCSB	DCMA	DCMB	DCWA	DCWB	DCSA	DCSB	EEMA	EEMB	EEWA	EEWB	EESA	EESB	Z2EA	Z2EB	Z2MA	Z2MB	Z2WA	Z2WB
GASTROPODA																								
Buccinum glaciale	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
Cylichna attonsa	10	1	8	7	1	2	3	3	3	2	7	1	0	1	2	1	4	4	0	0	1	0	0	0
Ocenebra interfossa	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
Philine polaris	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0
Polinices pallidus	0	0	0	0	1	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0
Vitrinella columbiana	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
SCAPHOPODA																								
Cadulus aberrans	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
Dentalium pretiosum	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
Rhabdus rectius	0	0	0	0	0	0	0	1	1	0	1	0	0	2	2	1	0	0	0	0	0	1	1	0
APLACOPHORA																								
Crystallophrisson sp. A.	3	0	5	2	2	0	0	0	0	0	2	3	2	0	4	0	3	0	1	0	1	0	0	1
Crystallophrisson sp. B	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AMPHIPODA																								
Bathymedon ?pumilus	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dulichia rhabdoplastis	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0
Heterophoxus oculatus	0	0	1	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Koroga megalops	2	1	0	2	0	0	1	1	1	1	0	1	0	0	0	0	1	0	0	0	0	0	0	0
Monoculodes cf. glyconica	0	0	0	0	0	0	1	0	0	0	1	2	1	0	0	0	0	0	0	0	0	0	0	0
?Oradarea longimana	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Orchomene obtusa	1	0	[illegible]	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Scina borealis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
DECAPODA																								
Pasiphaea pacifica	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
OSTRACODA																								
Rutiderma lomae	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CUMACEA																								
Eudorella pacifica	5	1	1	0	2	2	1	0	1	0	2	2	0	0	0	0	1	1	0	0	6	0	1	0
Diastylus unatillensis	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TANAIDACEA																								
Leptognathia gracilis	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HOLOTHUROIDEA																								
Chiridota albatrossi	3	4	1	2	0	3	1	1	2	1	1	4	2	2	5	2	5	7	0	0	1	1	0	2
Ctenodiscus crispatus	2	2	2	4	0	3	2	2	2	4	0	0	2	1	1	0	1	0	1	0	0	0	0	1
ECHINOIDEA																								
Strongylocentrotus sp. juv.	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
ASTEROIDEA																								
Solpadia intermedia	6	8	6	12	0	6	1	2	5	4	2	0	0	1	1	0	0	1	0	1	2	2	1	0
OPHIUROIDEA																								
Ophiura sarsi	7	3	5	5	0	10	1	0	1	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0
Ophiura leptoctenia	0	0	1	2	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Ophiura sp. juv.	0	2	0	0	0	1	0	1	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0
ANTHOZOA																								
Virgularia cystiferum	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	0	0	0	1	1

Appendix 3. Sigtree results for cluster analysis of Alice Arm (1989) stations based on species abundance data.



Linkage	Clusters Linked		Similarity	Prob
1	CCM	CCN	0.69528	0.20800
2	EEN	EEM	0.60714	0.31400
3	DDM	DDN	0.60086	0.25800
4	DDM	EEN	0.51373	0.25600
5	CCM	CCS	0.48526	0.26600
6	DDM	EES	0.42952	0.12600
7	Z2E	Z2W	0.40000	0.32800
8	CCM	DDS	0.38862	0.16000
9	CCM	DDM	0.33029	0.09000
10	Z2E	Z2M	0.29631	0.21000
11	CCM	Z2E	0.24322	0.09800

Appendix 4. COMTRE1 analysis results for comparison of Alice Arm species abundance dendrogram (tree 1) versus Alice Arm depths/ sediment particle size dendrogram (tree 2).

COMTRE1: Comparison of Two Dendrograms

Number of objects clustered = 12

TREE 1 read from: alic89.cm1
TREE 2 read from: aa89env.cm1

	TREE 1 Linkages		TREE 2 Linkages	
Linkage (i)	A(i)	B(i)	A(i)	B(i)
1	CCM	CCN	Z2E	Z2M
2	EEN	EEM	EEN	EEM
3	DDM	DDN	EEN	EES
4	DDM	EEN	CCM	CCN
5	CCM	CCS	DDN	DDS
6	DDM	EES	CCM	Z2W
7	Z2E	Z2W	DDM	DDN
8	CCM	DDS	CCM	Z2E
9	CCM	DDM	DDM	EEN
10	Z2E	Z2M	CCM	CCS
11	CCM	Z2E	CCM	DDM

Fowlkes Mallows Statistic

L1	L2	FM(L1,L2)	PROB	M1	S1	M2	S2
1	1	0.000000	1.0000	0.015152	0.122155	0.015152	0.122155
2	2	0.500000	0.0364	0.018182	0.093597	0.030303	0.120706
3	3	0.288675	0.6444	0.290571	0.085059	0.052486	0.115788
4	4	0.338062	1.0000	0.431833	0.081579	0.089638	0.112507
5	5	0.272166	0.8214	0.291595	0.054609	0.111340	0.107541
6	6	0.392232	0.0952	0.238175	0.063298	0.154516	0.099328
7	7	0.422577	0.5333	0.419855	0.062719	0.179275	0.097607
8	8	0.363803	0.7000	0.405787	0.086268	0.249885	0.093009
9	9	0.558957	0.6667	0.570982	0.067113	0.460815	0.060706
10	10	0.613941	0.6667	0.607206	0.010612	0.518262	0.045103
11	11	1.000000	1.0000	1.000000	0.000000	1.000000	0.000000

PROB = probability given the clusters defined at level L1 1
M1 = mean given the clusters at level L1-1
S1 = standard deviation given the clusters at level L1 1
M2 = mean given the cluster sizes
S2 = standard deviation given the cluster sizes